REMARKS

This is in response to the Office Action dated October 27, 2004. Claims 29-36, 38-70, 72-107, and 109-141 are pending. The clarification change to claim 29 does not raise any new issue.

The Section 103(a) rejections are respectfully traversed for at least the following reasons.

Claim 29 requires that "the substrate is at a temperature of 450 degrees C or more and less than 640 degrees C when the aluminum and ammonium are supplied." E.g. see the instant specification at page 13, lines 13-14. The cited art fails to disclose or suggest this aspect of claim 29. Moreover, this claimed temperature range provides for unexpected results as will be explained below.

Temperature is an important aspect of methods according to certain embodiments of this invention. It has been found that by using aluminum (Al) and nitrogen together in a deposition process involving Molecular Beam Epitaxy (MBE), it is possible to crystallize nitrogen into a mixed crystal in an efficient manner at temperatures of 450 degrees C or more. For example, in certain embodiments of this invention, a crystal is produced which is a mixed crystal with a composition including N, for example, AlGaAsN, AlGaInNAs, or the like. Using such a technique, it has surprisingly and unexpectedly been found that substrate temperatures much higher than the claimed range (e.g., 700 degrees C) are problematic because a nitride phase of AlGaN or the like, which is readily generated at high temperature(s), is mixed and causes phase separation including nitride phase separation (e.g., pg. 37, lines 1-14; Fig. 4; and Examples 5-6). It has also surprisingly been found that the appropriate temperature range for the use of Al and nitrogen in MBE is 450-640 degrees C. Another surprising result is that the claimed temperature

range results in the accelerated decomposition of ammonium and adsorption of N at or near the surface, thereby improving the introduction efficiency of N into a crystal.

Adomi discloses a method for making a semiconductor device which has an epitaxial layer of compound semiconductor alloy represented by (AlGa)InP doped with nitrogen. Adomi has a purpose of adding nitrogen as a low concentration impurity to operate as isoelectronic traps as discussed in col. 1, lines 23-25 of '201, and does not adopt nitrogen such as AlGaANP or the like as a material to be made of a mixed crystal as a composition order. Moreover, in direct contrast with the invention of claim 29, Adomi uses an undesirably high temperature of about 850 degrees C (col. 3, lines 21-22). The instant specification teaches that this is much too high and results in undesirable phase separation (e.g., pg. 37, lines 1-14). Moreover, one of ordinary skill in the art would not have used Tomomura's temperature in the technique of Adomi because there are different layer forming techniques involved in the two references (i.e., MOVPE in Adomi, and MBE in Tomomura). Tomomura does not describe using both aluminum and ammonium in this range. In other words, one of ordinary skill in the art would not have used the MBE temperature (580 degrees C) of Tomomura in the MOVPE system of Adomi because the deposition techniques in the two references are entirely unrelated to one another.

Furthermore, there is no suggestion in the art for using a temperature of 450-680 degrees C when forming a crystal layer using a combination of nitrogen and aluminum and required by these claims; and this claimed temperature range provides for unexpected results (e.g., pg. 37, lines 1-13). Neither Adomi nor Tomomura disclose using ammonium and aluminum together as a method of crystal growth at the temperature required by claim 29. Moreover, there is no motivation to combine the two references since Tomomura teaches using molecular beam epitaxy techniques to form layers, whereas Adomi is entirely different and uses metal organic

vapor phase epitaxy techniques. The two techniques are much different from one another and involve different temperatures. The alleged combination would never have been made.

Claim 63 requires that "the crystal is at a temperature of 450 degrees C or more and less than 640 degrees C when the ammonium is supplied." Moreover, claim 100 requires that "the crystal is at a temperature of 450 degrees C or more and less than 640 degrees C when the ammonium and aluminum are supplied." The cited art fails to disclose or suggest such requirements of these claims.

For at least the foregoing reasons, it is respectfully requested that all rejections be withdrawn. All claims are in condition for allowance. If any minor matter remains to be resolved, the Examiner is invited to telephone the undersigned with regard to the same.

Respectfully submitted,

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